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Holocene vegetation history of the Upper Dnister Plain region (Ukrainian Carpathians, north-western foreland)

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ABSTRACT. Holocene organic deposits derived from the Great Dnister Bogs territory situated on the north-western foreland of the Ukrainian Carpathians have been studied palynologically. Results of pollen analyses from three sections of peat deposits that accumulated during different parts of the Holocene are presented. The composite pollen diagram of these profiles has enabled the reconstruction of the vegetation history from the Late Glacial Younger Dryas to the Subatlantic phase of the Holocene. The information obtained demonstrates a good correlation with data for central Europe.

KEY WORDS: pollen, vegetation history, Younger Dryas, Holocene, foreland of Ukrainian Carpathians

INTRODUCTION

Palaeobotanical studies on the vegetation history of the Upper Dnister Plain started in the 1930s by Kostyniuk (1938)) who distinguished three phases of forest cover development during the Holocene: pine-birch forest, spruce-broad-leaved forest, and fir-beech forest. Thirty years later Cherevko (1967) continued investigations on this region but did not broaden considerably the idea of vegetation dynamics. She differentiated three sub-phases in the above-mentioned second phase: pine-birch forest; birch with elements of mixed oak forest; spread of moisture-requiring hornbeam, beech and fir. There were no profiles illustrated in those investigations which have been subjected to ^{14}C-dating. No attention was given to the problem of human impact on vegetation change even though archaeologists discovered many ancient settlements in this part of the Carpathian foreland (Matskevoy 1991, Machnik et al. 2000).

Owing to an initiative and financial support from Polish colleagues from the Jagiellonian University, the Polish Academy of Sciences, and the Polish Academy of Arts and Science multidisciplinary investigations (geomorphological, archaeological and palaeobotanical) have been undertaken in this region of Ukraine.

PRESENT DAY ENVIRONMENT OF THE UPPER DNISTER PLAIN REGION

The region investigated is located at the foreland of the Eastern Carpathians (Fig.1). From a geomorphological point of view it constitutes the Upper Dnister sandr-alluvial plain (Cys 1962) which has an altitude of 260–270 m a.s.l. and a monotonous and flat landscape. From the west and north it is surrounded by the Dnister channel, from the south by the Drohobych Upland and from the east by the Bystrytsia River – the right-side tributary of Dnister (Fig. 1). The plain extends from north-west to south-east and is 10–12 km wide and 40 km long.

From a geobotanical point of view the investigated territory belongs to the central Euro-

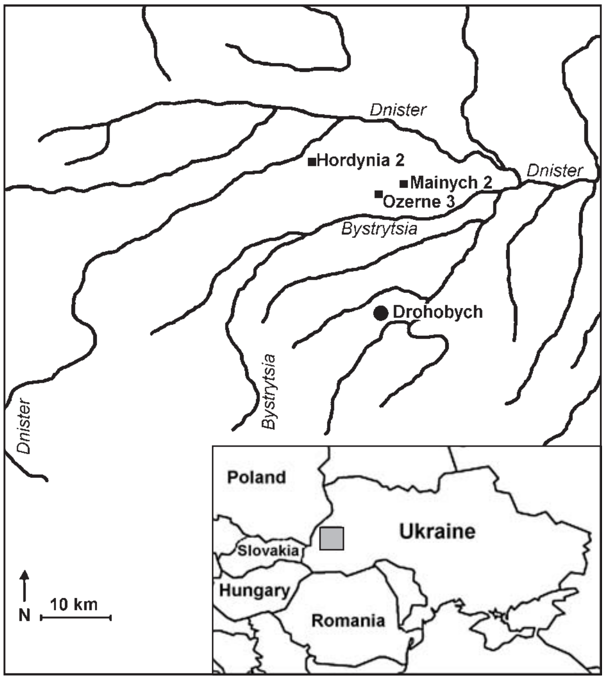

Fig. 1. Location of investigated sites (■): Hordynia 2, Ozerne 3, Mainych 2

pean province of the European broad-leaved mixed forest area (Barbarych 1977). Until the 19th century the substantial territory of the Upper Dnister Plain was a swamped are and had the name of the Great Dnister Bogs (Hołowkiewicz 1884). The total area of the Great Bogs reached 12 000 hectares. After the long history of land draining which finished in the 1970s the meadow communities have formed the greatest complex of the Plain vegetation (Shelag-Sosonko et al. 1982).

The actual vegetation of the Great Dnister Bogs is represented by only a few types of plant community. They are forests, meadows, flood meadows, hygro- and hydrophyte communities, ruderal and segetal associations (Resler 2003).

Forested regions cover no more than 10–15% of the flood plain. Forests from 1 to 4 km^2 of area are sparse in the territory of the Dnister valley and are the *Ribo nigri-Alnetum* association and its derivatives (Tkachyk & Resler 2002, Resler et al. 2002). Along the Dnister channel communities of the *Salicetea purpurea* class expand. Pine forests are absent from the Upper Dnister Plain.

Meadow vegetation is dominant on the flood plain. Mosaic small (1–2 m) depressions and rising ground characterize the otherwise flat relief causing a mosaic occurrence of xero-, meso- and hygrophyte meadow communities. In the central part of the Dnister valley and on the rising grounds the *Molinio-Arrhenatheretea* class is represented by associations of the *Arrhenatheretalia* order. In the small depressions the communities of the *Calthion alliance* are dominant. Associations of the *Phragmiti-Magnocaricetea* class occupy moist areas. Near the river channel the communities of *Magnocaricion elatae*, *Caricion gracilis*, *Caricion rostratae*, *Phalaroidion arundinaceae*, and *Phragmition communis* alliances are spread (Resler & Tkachyk 2001).

Aquatic vegetation concentrates in the artificial ponds formed in waste peat-cutting pits, soil-reclamation canals and former riverbeds. There are associations of *Lemnion minoris*, *Utricularion vulgaris*, *Hydrocharition*, *Potametion lucentis*, and *Potametion pusilli* alliances.

The largest part of the natural vegetation is transformed in cultural phytocoenoses. The significant part of the Upper Dnister Plain is covered with the agrocoenoses of the *Secalietea* class. Ruderal communities of the *Artemisietea vulgaris* class are represented fragmentarily. At the flood valley borders near sites of human habitation and on nitrificated substrata, associations of *Arction lappae* alliances occur. Everywhere on the pasturelands and field roads the synanthropic communities of the *Plantaginetea majoris* class are present.

MATERIAL AND METHODS

The samples for palynological analysis were taken from borings of organic sediments of three profiles: Ozerne 3, Mainych 2 and Hordynia 2 (Fig. 1), carried out with a Geomeres borer.

Site Ozerne 3 (49°31′N, 23°32′E) is situated near the village Ozerne at the Bystrytsia valley border.

Profile description, depth in m

0.00–0.50	sand and loam (embankment)
0.50–0.63	peat soil
0.63–1.00	loam
1.00–2.00	sand
2.00–2.65	silt loam
2.65–2.78	well-decomposed peat
2.78–2.82	organic loam
2.82–2.90	peat
2.90–3.18	organic loam
3.18–3.78	decomposed peat
3.78–3.85	peat loam
3.85–4.20	decomposed peat
4.20–4.60	peat loam
4.60–6.00	silt loam

Wklejka, Fig. 2 po stronie 168.

Mainych 2 profile (49°31′N, 23°29′E) is located about 500 m from the edge of a peat plain north of village Mainych.

Profile description, depth in m

0.00–0.25 black fen soil
0.25–2.75 loam
2.75–3.00 fine-grained sand
3.00–5.00 loam
5.00–5.56 sand
5.56–6.00 peat brown-black
6.00–6.50 decomposed peat
6.50–6.63 sandy loam
6.63–6.67 clayey loam
6.67–6.74 peat loam
6.74–6.81 organic silt
6.81–7.20 peat dark brown with rusty concretions
7.20–8.80 loam
8.80–9.00 sandy loam
9.00–10.00 sands and gravels up to 2 cm of diameter

Profile Hordynia 2 (49°33′N, 23°25′E) is located about 100 m from right embankment along Dnister river channel.

Profile description, depth in m

0.00–0.82 clayey loam
0.82–2.00 decomposed peat
2.00–4.20 organic silt with inclusions of peat
4.20–5.72 clay with inclusions of silt
5.72–7.50 loamy sand
7.50–9.00 sand

In the Ozerne 3 profile the samples from depth of 2.62–4.60 m were taken for palynological research. Pollen analysis of Mainych 2 profile was performed for peat layers (5.60–6.50 m). In Hordynia 2 profile the samples for pollen analysis were taken from depths of 0.74–2.30 m and 3.00–3.47 m.

Material was prepared with a standard procedure: treated with 10% KOH, hydrofluoric acid followed by Erdtman's acetolysis (Erdtman 1943). Not less then 200 pollen grains of trees and shrubs (AP) were counted in each sample. The pollen diagram composed of three profiles was plotted using the computer program POLPAL (Walanus & Nalepka 1999). The percentage values of particular taxa were calculated on the basis of the total pollen sum including trees, shrubs and herbs excluding Cyperaceae, aquatic, swamp and spore plants. The percentage values of each plant group were calculated on the basis of abovementioned sum adding a respective taxon.

Seven samples of peat sediments were dated in the Radiocarbon Laboratory, of the Silesian Technical University at Gliwice (Poland). All dates are given as radiocarbon years before present (BP).

DESCRIPTION OF POLLEN ZONES AND CHRONOSTRATIGRAPHY

The results of pollen analysis and radiocarbon data are presented in a composite diagram shown (Fig. 2). Samples 1–6 belong to the Hordynia 2 profile, 7–22 to the upper part of Ozerne 3 profile, 23–40 belongs to the Mainych 2 profile, 41–53 to a lower part of the Ozerne 3 profile. Ten pollen assemblage zones (PAZ) have been distinguished in the diagram.

***Pinus*-*Pinus cembra*-*Betula nana* (*Pi*-*Pic*-*Bet n*.)** PAZ (samples 53–46)

In this zone tree pollen is dominant, in particular *Pinus* undiff. (max. 65%), *Pinus cembra* (max. 15%), *Picea* (max. 10%). The curve of tree and shrub pollen falls to 68% at the upper boundary of the zone. Simultaneously the percentage of Poaceae, *Artemisia* and Chenopodiaceae rises. This fact as well as the presence of pollen grains of *Betula nana* type and *Larix* indicates that this zone represents the Younger Dryas (YD) period. Among other trees and shrubs a small quantity of *Quercus*, *Tilia*, *Carpinus*, *Fagus*, *Abies*, *Corylus*, and *Betula* pollen is present. Hydrophytes are presented with significant values of *Myriophyllum* pollen (max. 10%).

In the lowest sample pollen of thermophilous *Nymphaea* are present and *Betula nana* absent, giving some probability for accepting the age of this sample to be Allerød.

***Pinus*-NAP (*Pi*-NAP) PAZ** (samples 45–43)

AP pollen curve rises rapidly to the level of 95% mainly because of *Pinus* undiff. (max. 90%). The *Pinus cembra* pollen decreases and then disappears. The curves of Poaceae and *Artemisia* are showing a tendency to decline. Sample No. 44 was ^{14}C dated to 9810 ± 120 years BP. This zone corresponds to the Preboreal chronozone (PB).

***Picea*-*Pinus* (*Pic*-*Pi*) PAZ** (samples 42–39)

The *Pinus* curve decreases to 45% after a short period of the slow decline. The total curve of trees and shrubs rises again in the younger part of the zone. The total curve of herbs does not exceed 20% (owing to Poaceae) in the central part of zone. The contribution of *Picea* increases rapidly from 5% at the lower boundary to 18% at the upper boundary of the zone. Other tree curves (*Alnus*, *Betula*, *Corylus*, *Quercus*, *Ulmus*, and *Tilia*) demonstrate a slow tendency to increase. This zone presents the Boreal chronozone (BO).

***Picea*-*Alnus*-*Salix* (*Pic*-*Al*-*Sa*) PAZ** (samples 38–34)

The *Pinus* curve decreases to 20% and after a small fluctuation increases to 55% in the last sample of this zone. The *Picea* curve keeps near the level of 15% with slight variations. The *Alnus* pollen curve has two peaks of 25% and 30%, and significant values of *Salix* pollen are present. Average quantity of deciduous tree pollen increases in comparison with the preceding zone. In sample 36 *Quercus*, *Ulmus*, *Fraxinus*, *Corylus* pollen is absent and this is correlated with a *Salix* and Poaceae maximum (9% and 30% respectively). Cyperaceae pollen values fluctuate, rising from 10% to 45%. The hydrophytes are represented by *Sparganium* (max. 12%). The sample No. 34 is dated at 7530 ± 110 BP. This zone corresponds to the older phase of the Atlantic chronozone (AT).

***Picea*-*Ulmus*-*Quercus* (*Pic*-*Ul*-*Qu*) PAZ** (samples 33–30)

The *Pinus* curve slightly fluctuates near the level of 50%. *Picea* pollen fluctuates between 20% and 10%. Among deciduous trees *Ulmus* (max. 16%) and *Quercus* (max. 13%) are dominant. The *Tilia* curve is interrupted. The pollen sum of herbs does not exceed 12%. In some samples with 4% of *Artemisia* pollen are present. The percentage values of Cyperaceae pollen are remarkable though, and from the first sample of this zone pollen grains of Cyperaceae are absent. In the same sample curve of Filicales monolete spores rises to 70%.

***Ulmus*-*Corylus* (*Ul*-*Co*) PAZ** (samples 29–27)

The total AP curve maintains values near 90%. *Pinus* pollen values fluctuate from 25% to 50%. The *Picea* curve falls to 10%. Among deciduous trees *Corylus* pollen is predominant (max. 20%). In the sample where *Corylus* has maximum *Betula* rises to 13% and *Rumex, R. acetosella* type and *R. acetosa* type pollen is present. In the last sample of this zone the curve of *Ulmus* begins slightly to decrease.

***Quercus*-*Corylus*-NAP (*Qu*-*Co*-NAP) PAZ** (samples 26–23)

After a slight fluctuation the NAP curve rises to 33%. *Picea* value rises in one sample and then falls again to 8%. The curves of all deciduous tree taxa decrease at the end of this zone and the *Fraxinus* pollen curve is interrupted. The Cerealia pollen of *Avena* type and *Hordeum* type as well as pollen of synanthropic taxa occurs in significant proportions in the samples of this zone. The sample No. 23 is dated at 5410 ± 70 years BP. This zone corresponds to late phase of the Atlantic chronozone.

***Picea*-*Pinus* (*Pic*-*Pi*) PAZ** (samples 22–11)

The total tree pollen curve exceeds 80% but falls to 70% near the upper boundary of the zone. *Pinus* and *Picea* pollen dominate in all samples of zone. The average values of all deciduous trees are lower than in the preceding zone. In some last samples *Carpinus, Fagus* and *Abies* curves appear. The *Artemisia* pollen curve is generally continuous while other synanthropic taxa occur sporadically. This zone belongs to the Subboreal (SB) chronozone.

***Quercus*-*Carpinus*-*Fagus*-*Alnus* (*Qu*-*Ca*-*Fa*-*Al*) PAZ** (samples 10–7)

The total AP sum curve fluctuates near 70–80%. *Pinus* pollen values decrease to 10–15%. In the pollen spectrum of deciduous trees *Quercus*, *Carpinus* and *Fagus* are equally dominant. This zone is characterized by significant values of *Alnus*, hygro- and hydrophyte pollen. The Cerealia and *Artemisia* curves are continuous. The sample No. 8 is dated at 2000 ± 60 years BP. This zone represents the beginning of the Subatlantic chronozone (SA).

***Betula*-NAP (*Bet*-NAP) PAZ** (samples 6–1)

The total AP curve continuously falls though this zone. *Quercus, Carpinus,* and *Fagus* pollen values are considerably lower than in the preceding zone. In some samples *Quercus*, *Ulmus,* and *Fagus* curves are interrupted. *Tilia* and *Corylus* pollen is absent. Among Cerealia *Secale cereale* pollen appears. The *Artemisia* curve is persistent. Other synanthropic taxa occur sporadically. Poaceae values continuously rise to 40%. Two samples of this zone are dated: No. 6 at 1910 ± 120, and No. 1 at 610 ± 120 BP.

VEGETATION CHANGES

The proportion of tree pollen values exceeding 80% at the beginning of *Pinus-Pinus cembra-Betula nana*-PAZ evidences the presence of forest communities on the territory of the Upper Dnister Plain in the Younger Dryas. They were characterized by the development of pine-forests with *Pinus sylvestris* and probably *P. cembra*. The values of *P. cembra* pollen of 16% does not give a full confidence that this species occurred in situ in the Upper Dnister Plain during the Late Glacial period. However, the occurrence of macrofossil remains belonging to the Late Glacial deposits in the Polish Carpathians foreland (Krauss et al. 1965, Szczepanek 1971) suggests that *P. cembra* might have grown at that time in the studied territory. It also grew at the low altitudes in the neighbouring Carpathian foothills (Ralska-Jasiewiczowa 1980). A slight fluctuation of the *P. cembra* curve has the opposite trend to *P. sylvestris*. From this it may be assumed that the low competitive *P. cembra* conceded territory to *P. sylvestris.*

The 10% value of *Picea* is interpreted as a result of spruce growing in the Upper Dnister Plain or in the close vicinity. Light-requiring *Betula nana*, *Larix*, *Juniperus*, and *Salix* also occurred. The presence of *Quercus*, *Tilia*, *Acer*, *Corylus*, and even *Carpinus*, *Fagus*, and *Abies* pollen in the samples corresponding to the Younger Dryas chronozone is problematic in this PAZ. There are single or several pollen grains of each of these taxa in the samples. It may be interpreted as contamination. On the other hand, pollen of the mentioned taxa disappeared in the last sample of *Pinus-Pinus cembra-Betula nana*-PAZ simultaneously with a decrease of total sum of AP. As it is well known in the final stage of the Younger Dryas period the climate of central Europe became more severe and continental, and the forest area reduction affected increasing of NAP-pollen percentage in corresponding samples of the presented diagram. Other diagrams from the western Ukrainian sites (Bezusko & Bogutsky 1986, Bezusko et al. 1985) and from south-eastern Poland (Harmata 1995, Mamakowa 1962) demonstrated the similar presence of deciduous tree pollen in the Late Glacial deposits. The author agrees with Mamakowa (1962) who explained that those deciduous trees had not yet entered the forest communities but grew in the neighbouring refuge. Steppe-like communities with Poaceae, Chenopodiaceae, Brassicaceae, *Artemisia*, *Centaurea cyanus*, *Polygonum aviculare*, and sparsely growing pine-trees occupied the investigated territory in the late phase of the Younger Dryas period. *Betula*, *Alnus* and *Salix* were growing scarcely in the swamp communities.

After the Younger Dryas climatic deforestation the Preboreal stage of the Holocene was marked by a rapid increase of trees participation in plant associations. In the investigated area it was mainly *Pinus* with some admixture of *Picea*. Light-requiring *Betula nana*, low competitive *Pinus cembra* and *Larix* disappeared from the plant communities. Xerophytic and heliophilous communities with *Artemisia*, Chenopodiaceae, *Ephedra* occupied small areas. This transitional Late Glacial – Holocene period is very similar to that in region of the Polish Carpathians foreland near Dębica (Mamakowa & Starkel 1977, Starkel & Granoszewski 1995).

At the beginning of the Boreal period the pine forest gave way to spruce communities with some participation of *Quercus*, *Ulmus*, *Tilia*, and *Corylus*. Those deciduous trees appeared simultaneously on the territory of the Upper Dnister Plain. There are no evidences of *Ulmus* coming into boreal forests earlier as it was described for other areas of the similar regions (Starkel & Granoszewski 1995, Harmata 1989, Mamakowa 1962). It may be explained as unfavourable conditions for the elm growth resulted from stagnant ground water (Gofshtein 1962). The *Ulmus* pollen contribution in all discussed profiles did not exceed 16%. The participation of above mentioned deciduous trees in forest communities increased towards the final stage of the Boreal.

A further significant decrease in the abundance of *Pinus* in forests and also a slight drop in *Picea* characterized the beginning of the Atlantic period. The role of deciduous trees increased. During the first half of the Atlantic period this rise was continuous with some fluctuations, which showed an opposite tendency to that observed for *Pinus* and *Picea*. It may be explained by climatic oscillations when the climate deterioration caused boreal elements to return into plant communities. From one anlysed sample of Atlantic deposits *Quercus*, *Ulmus*, *Fraxinus*, and *Corylus* pollen are absent. Coincidentally the significant increase in hygro- and hydrophytes and *Salix* was observed. So it may be concluded that the considerable soil moisture caused those trees to leave the bog territory. The 2% presence of *Carpinus* pollen in this sample is inexplicable from the point of view of contemporary vegetation.

The contribution of herbs remained relatively low with some oscillations. If these changes had correlated with the appearance of synanthropic plants it could have been concluded that they were evidences of human activity, especially in the samples containing the Cerealia pollen. The oldest sample with

Cerealia pollen is located higher than the layer dated at 7530 ± 110 BP and lower than 5410 ± 70 BP. In another profile from the Upper Dnister Plain with frequently dated samples (Harmata & Kalinowicz 2001) the first Cerealia pollen occurred near the 7000 years BP.

The transition between Atlantic and Subboreal periods is characterized by the increase of *Picea* in plant communities. In the Subboreal phase of Holocene *Picea* reached its maximum. However *Pinus* did not return to its position. Pollen of Cerealia is absent from samples corresponding to the Subboreal period but the presence of remarkable value of *Artemisia* becomes permanent. In the last sample of the Subboreal period the curves of *Carpinus*, *Fagus*, and *Abies* become continuous.

The first sample of the Subatlantic period is characterized by rapid increase of hornbeam, demanding to the climate humidity beech and fir, and especially alder, simultaneously with the sudden rise of proportions of the swamp and aquatic communities in the investigated area. The contributions of *Pinus* and *Picea* pollen fall to low percentages. From the beginning of the Subatlantic period the permanent decrease of trees participation in the Upper Dnister Plain was observed though the *Pinus* and *Betula* percentages in pollen spectra rise in the younger part of Subatlantic. *Carpinus*, *Fagus*, *Quercus*, and aquatic pollen declined coincidentally with the increase in *Abies* and Cerealia pollen. It could be supposed that a climatic factor could have been associated with an effect of human activity.

CONCLUSIONS

The present study is based upon the analysis of palaeobotanical material obtained from three profiles. None of investigated sites contained the full range of Holocene deposits, nevertheless, the three profiles together made it possible to reconstruct the vegetation history of the Upper Dnister Plain from the Younger Dryas up to the Subatlantic phase of the Holocene.

It may be concluded that the main tendencies of the vegetation successions in region under discussion were similar to the other parts of central Europe. Some differences were expressed in the small participation of *Tilia* and *Fraxinus* in the Atlantic forest communities. *Ulmus* and *Corylus* proportions were also low. This may be influenced by the geomorphological construction of the Upper Dnister Plain which provoked the stagnation of ground water in a great area of about 12 000 hectares. Such local soil conditions were unfavourable for the growth of the above-mentioned trees. The fluctuations in the hygro- and hydrophytes proportion have frequently opposite tendencies to deciduous tree participation. The geomorphological features of the investigated region caused sharp expression of climate humidity in the plain vegetation at the beginning of the Subatlantic period. Significant soil moisture caused the spread of hydrophilous herb communities and swamp alderwood.

The human impact on the Upper Dnister Plain vegetation also depended on climate fluctuations. Due to the water level rise the people left the swamped territory. From about 2500 years ago the continuous deforestation of investigated area and surrounding regions started. It resulted in the significant decrease of AP pollen proportions in discussed diagram though some pioneer trees participation considerably increased.

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REFERENCES

BARBARYCH A. (ed.). 1977. Geobotanichne rajonuvannia Ukrainskoi RSR (Geobotanical division of Ukrainian RSR). Naukova Dumka, Kyiv. (in Ukrainian).

BEZUSKO L. & BOGUTSKY A. 1986. Novi dani pro roslynnist zahidnyh oblastej Ukrainy u verhmiomu pleistotseni (summary: A new data about the vegetation of western regions of Ukraine in the upper Pleistocene). Ukrain. Botan. Zhur., 43(1): 47–51.

BEZUSKO L., KAJUTKINA T., KOVALUH M. & ARTUSHENKO O. 1985. Paleobotanichni ta radiohronologichni doslidzhennia vidkladiv bolota Starnyky (Male Polissia), (summary: Palaeobotanical and radiochronological investigation of Starnyky Bog sediments, Male Polissia). Ukrain. Botan. Zhur., 42(3): 27–30.

CHEREVKO M. 1967. Materialy do istorii roslynnosti Prykarpattia v pislalodovykovyj period (summary: The facts for the vegetation history of Carpathians foreland after the glacial). Visnyk Lvivskovo Derzhavnovo Universytetu, Ser. Biologichna, 3: 102–111.

CYS P.M. 1962. Geomorfologia URSR (Geomorphology of USSR). Vydavn. Lviv Univer., Kyiv. (in Ukrainian).

ERDTMAN G. 1943. An introduction to pollen analysis. Chronica Botanica, Waltham, Massachusetts.

GOFSHTEIN I.D. 1962. Neotektonika i morfogenez Verhniovo Prydnistrovia (New tectonics and morphogenesis of Upper Dnister region). Vydavn. AN URSR, Kyiv. (in Ukrainian).

HARMATA K. 1989. Type region P-d: The Jasło-Sanok depression. In: Ralska-Jasiewiczowa (ed.) Environmental changes recorded in lakes and mires of Poland during the last 13 000 years. Part three. Acta Palaeobot., 29(2): 25–29.

HARMATA K. 1995. A Late Glacial and early Holocene profile from Jasło and the recapitulation of the studies on the vegetational history of the Jasło-Sanok depression in the last 13 000 years. Acta Palaeobot., 35(1): 15–45.

HARMATA K. & KALINOWICZ N. 2001. Ślady działalności człowieka w diagramach pyłkowych z dorzecza górnego Dniestru: 223–234 In: Gancarski J.(ed.) Neolit i początki epoki brązu w Karpatach polskich. Materialy z Sesji Naukowej Krosno, 14–15 .12. 2000.

HOŁOWKIEWICZ E. 1884. Bagna naddniestrzańskie. Sylwan: 124–133.

KOSTYNIUK M. 1938. Analiza pyłkowa dwóch torfowisk w okolicy Rudek i Sambora. Kosmos, A, 63(3): 393–412.

KRAUSS A., MYCIELSKA-DOWGIAŁŁO E. & SZCZEPANEK K. 1965. Wstępne wyniki badań nad wiekiem osadów doliny Wisły pod Tarnobrzegiem (summary: Preliminary data on the age of the deposits in the Vistula River valley near Tarnobrzeg). Przegl. Geol., 47(6): 275–280.

MACHNIK J., PAWLIW D., PETEHYRYCZ W. & HRYBOWYCZ R. 2000. Prachistoryczne kurhany na podkarpackich wysoczyznach górnego Dniestru: 185–207 In: Rydzewski J. (ed.) 150 lat Muzeum Archeologicznego w Krakowie. Kraków.

MAMAKOWA K. 1962. Roślinność Kotliny Sandomierskiej w późnym glacjale i holocenie (summary: The vegetation of the basin of Sandomierz in the Late Glacial and Holocene). Acta Palaeobot., 3(2): 3–57.

MAMAKOWA K. & STARKEL L. 1977. Stratigraphy of Late Glacial and early Holocene alluvia at Podgrodzie on the Wisłoka River (SE Poland). Stud. Geomorph. Carpatho-Balcan., 11: 101–110.

MATSKEVOY L. 1991. Mezolit Zapada Ukrainy (Mesolythic period in The West Ukraine). Naukova Dumka, Kiev. (in Russian).

RALSKA-JASIEWICZOWA M. 1980. Late Glacial and Holocene vegetation of the Bieszczady Mts. (Polish Eastern Carpathians). PWN, Warszawa-Kraków.

RESLER I. 2003. (unpubl.) The Great Dnister Bogs vegetation. Lviv.

RESLER I. & TKACHYK V. 2001. Vodno-bolotna flora i roslynnist terytorii Velykyh Dnistrovskyh Bolit (summary: Water-bog flora and vegetation in the territory of Great Dnister Bogs). Naukovyj Visnyk Uzhorodskovo Natsionalnovo Universitetu. Ser. Biologia, 10: 65–68.

RESLER I., KALINOVYCH N. & HARMATA K. 2002. Vilshyny Verhniodnistrovskoi Rivnyny ta istoria ih pohodzhennia (summary: Alder forests in Upper Dnister Plain and history of their origin): 279–286. In: Ya.Didukh (ed.) Yu.D. Kleopov ta suchasna botanichna nauka. Fotosotsiotsentr., Kyiv.

SHELAG-SOSONKO J.R., OSYCHNIUK W.W. & ANDRIJENKO T.A. 1982. Gieografiya rastitielnovo pokrova Ukrainy (The vegetation geography of Ukraine). Naukova Dumka, Kiev. (in Russian).

STARKEL L. & GRANOSZEWSKI W.1995 The Younger Dryas palaeomeander of the Wisłoka river at Wola Żyrakowska near Dębica. Geographical Studies, Spec. Issue, 8: 91–100.

SZCZEPANEK K. 1971. Historia limby w Polsce: 7–13 In: Białobok S. (ed.) Limba *Pinus cembra* L. PWN, Warszawa-Poznań.

TKACHYK V. & RESLER I. 2002 Ugrupovannia assotsiatsii Ribo nigri Alnetum-Górniska 1975 Velykyh Dnistrovskyh Bolit (summary: Associations *Ribo nigri – Alnetum* Solinska – Górniska 1975 of Great Dnister Bogs). Naukovyj Visnyk Lvivskogo Natsionalnogo Universitetu im. I. Franka, Ser. Biologichna, 28: 105–113.

WALANUS A. & NALEPKA D. 1999. POLPAL. Program for counting pollen grains, diagrams plotting and numerical analysis. Acta Palaeobot., Suppl., 2: 659–661.